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Field Evaluation of Lentil (*Lens culinaris Medik*) Genotypes: A Step towards Climate-Resilient Pulse Farming in Indo-gangetic Plains of North Western Bihar, India

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ABSTRACT

Lentil (Lens culinaris Medik) is one of the oldest domesticated grain legumes which is grown widely throughout the Indian subcontinent. Consequently, lentils has have evolved over a broad range of growing environments globally, which infers broad genetic variation and yield. The unpredictable weather patterns existing in the Indo-gangetic Plains of North Western Bihar, India has affected pulse crop production in general and Lentil in particular. Therefore field evaluation of promising lentil genotypes were carried out with identifying superior adaptability and yield stability as a strategy for pulse farming. In changing, climate scenarios, eight genotypes of lentil were tested in Krishi Vigyan Kendra, Bhagwanpur Hat, Siwan, Bihar (India) during Rabi, 2022-23 for its suitability in the region. SVT/Lentil (2022-23)/6 lentil variety recorded superiority of yield (1200 kg ha^{-1}) and yield attributing characters such as plant height (36.57 cm), number of branches per plant (24), and days to 50 % flowering (54 days). Therefore, SVT/Lentil (2022-23)/6 may be suitable genotype for Indo-gangetic plains of North-Western Bihar region of India in terms of yield which was followed by SVT/Lentil (2022-23)/5 variety which recorded yield if 1050 kg ha^{-1}. Multi location testing will help in promoting these varieties for seed production and large scale cultivation by farmers. The unpredictable weather patterns existing in the Indo-gangetic Plains of North Western Bihar, India has affected pulse crop production in general and Lentil in particular. Therefore field evaluation of promising lentil genotypes were carried out with identifying superior adaptability and yield stability as a strategy for pulse farming.

Keywords: *Lentil, State Varietal Trial, Genotypes, Yield and Yield attributes, Indo-Gangetic Plains, Climate change.*

Introduction

Through traditional seed breeding, humans have developed thousands of different varieties of food crops across the world. By pProtecting seed diversity, it will allow farmers to control their food system, protect biodiversity, and build resilience against climate change. A variety trial entails growing different varieties of a crop alongside each other in order to directly compare their performance across any number of characteristics. As in conventional legume breeding programmes, variety releasing is performed after exhaustive variety trials conducted on different agro-ecological conditions [1].

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In conventional breeding programmes, varietal maintenance is conducted by breeders from the National Institutes of Agriculture Research. This duty is performed using seeds from “breeder's stock” or selected row-plant progenies, applying proper selection protocols to obtain “breeder's seed” or “foundation seed” (this depending depends on seed legislation). Also, “rouging” off-types plants (before flowering) from seed production fields increases genetic quality across seed categories in the formal seed systems in legume crops [2]. On the other hand, variety maintenance in plant breeding (PB) programmes is not performed in the same way. Instead, the genetic makeup of varieties is seen as “dynamic” that could be shaped up by selection as needed. Although this principle may seem somewhat disadvantageous for crop intensification, its existence contributes significantly to resilience to climate change. It is difficult to states differences between varietal maintenance and the genetic improvement process itself, this being a continuous process according to local needs. However, this is an advantage over conventional/formal systems whose variety generation process takes too many years to have an impact on immediate needs. It is very difficult for the varieties obtained from PB to find a place in the regulations established for formal systems. This is because these legume varieties developed are not uniform and fail the conventional tests regarding "uniformity" and "stability." In addition to not having an endorsement of its "distinction" to how it is done with improved varieties and its possible use in value chains. ButHowever, the farmers participating in PB processes are most likely not interested in having their varieties duly registered in the formal system since their dynamics of the distribution of varieties and seeds is are very different. Many farmers exchange their seeds freely without having to request permits from regulatory entities. Their registration and regulation, if possible, significantly would limit and makes the use of seeds more expensive [1]. Lentil (*Lens culinaris* Medik.; Fabaceae) is among the major cool cool-season annual grain legume crops, and is best adapted to semi-arid regions of the Mediterranean Basin and the Indian subcontinent. It is among the oldest crops, together with cereals like barley and wheat and is probably the oldest domesticated grain legume because carbonized remains of lentils were found in the Franchthi cave in Greece, dated 11,000 BC, and from Tell Mureybit in Syria, dated 8500–7500 BC. Lentil is the fourth major cool season grain legume in the world after dry pea (*Pisum sativum*), chickpea (*Cicer arietinum*) and broad bean (*Vicia faba*) produced for human consumption, and it constitutes an excellent source of complex carbohydrates, protein, minerals, vitamins and dietary fibers for humans, as well as being highly valuable as feed and fodder for livestock. As well as its prominent role in the food and feed industry, lentils are also grown for the diversification and intensification of cropping systems. It exhibits ecological advantages as a rotational crop in cereal-based cropping systems by acting as a break crop for the better control of pests, weeds and diseases, and the better management of herbicide residue, and at the same time plays an important role in maintaining soil fertility due to its capacity to fix atmospheric nitrogen (N_2). For instance, the range in the quantity of N_2 fixed by *Lens esculents* Medik. through bacteria (*Rhizobium*) reaches 40–68 kg ha^{-1} year^{-1} [3]. Increase An increase the production and productivity of lentils can be achieved by choosing right kind of variety at a particular agro-climatic and agro-ecological zone. The variety of lentil at a specific locality also varies via physical, physiological and morphological attributes which directly or indirectly influences the yield and other characteristics. Keeping these points in view, the present study was conducted as a varietal trial of lentil in Krishi Vigyan Kendra, Bhagwanpur Hat, Siwan under state varietal trial (SVT) programme of Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar.

Material and Methods

The field experiment for the investigation of the work was carried out in 2022-23 of the *Rabi* Season at Krishi Vigyan Kendra, Bhagwanpur Hat, Siwan farm.

The experiment was laid out in a randomized block design with four replications and eight varietal trial lines as treatments (Table 1). Plot size includes six number of rows, row length of 4 m, row to -to-to-row distance of 25 cm, plant to -to-plant distance of 10 cm, gross plot size of 6 m^2 and net plot size of 6 m^2. Basal dose of 20:40:20: 10 kg NPKS ha^{-1} and date of sowing was 21/12/2022. The data were taken from the field for seed yield (Kg/ha), 100 seed weight (g), 50% flowering (Days), maturity (Days), plant height (cm), No. of branches/plant and No. of pods/plant.

Table 1: SVT trial varietal code of Lentil

Sl. No.	Variety / Code
1	SVT/Lentil (2022-23)/1
2	SVT/Lentil (2022-23)/2
3	SVT/Lentil (2022-23)/3
4	SVT/Lentil (2022-23)/5
5	SVT/Lentil (2022-23)/6
6	SVT/Lentil (2022-23)/7
7	SVT/Lentil (2022-23)/8
8	SVT/Lentil (2022-23)/9

Results and Discussion

Lentil Phenology

Rate The rate of development varied across the genotypes screened for growth attributes of the lentil crop. The SVT/Lentil (2022-23)/06 recorded superior data with respect to plant height (36.57 cm), number of branches per plant (24), and days to 50 % flowering (54 days) which was had having longest reproductive window and maturity (87 days). Among the lentil varieties trialed lowest plant height was observed in SVT/Lentil (2022-23)/3 (31.30 cm), lowest number of branches per plant was observed in SVT/Lentil (2022-23)/2, SVT/Lentil (2022-23)/7, SVT/Lentil (2022-23)/8 and SVT/Lentil (2022-23)/9. On an average, among all varieties difference in 50 % flowering showed one (52 days) to four (55 days) days difference which decides the earliness of the harvesting window of the genotypes tested. Number The number of branches per plant varied from 12 to 24 of which the highest was noted in SVT/Lentil (2022-23)/6. Variations in phenological characters are governed by their performance in respective regions which are influenced by various factors such as genetics, climate and soils [4].

Lentil Yield attributes

Yield and yield attributes majorly decides the suitability of a genotype to promote in seed production chain for a region. Yield one among of the important parameters that decides the choice among the farmers to select selected for production. Higher yield was recorded in **S**VT/Lentil (2022-23)/6 followed by SVT/Lentil (2022-23)/5 and SVT/Lentil (2022-23)/4 with respective seed yield of 1200, 1050 and 1000 kg ha^{-1}. Test weight (100 seed weight) was recorded highest as mentioned previously in the same order with respective weights of 2.37, 2.18 and 2.14 g. Maturity of pods was observed late (87days) in SVT/Lentil (2022-23)/5 and SVT/Lentil (2022-23)/6 and early maturity (84 days) was recorded in SVT/Lentil (2022-23)/1 and SVT/Lentil (2022-23)/2. These variations might be due to the genetic make up of the genotypes tested [5].

Table 2: Yield and growth attributed of lentil Lentil genotypes

Sl. No.	Variety / Code	Seed Yield (Kgha^{-1})	100 Seed weight (g)	50% Flowering (Days)	Maturity (Days)	Plant height (cm)	No. of branches/ plant	No. of Pods/ plant
1	SVT/Lentil (2022-23)/1	804	1.92	55	84	33.80	14	36
2	SVT/Lentil (2022-23)/2	640	2.01	52	84	34.10	12	33
3	SVT/Lentil (2022-23)/3	1000	2.14	52	85	31.30	18	38
4	SVT/Lentil (2022-23)/5	1050	2.18	53	87	32.50	20	45
5	SVT/Lentil (2022-23)/6	1200	2.37	54	87	36.57	24	47
6	SVT/Lentil (2022-23)/7	830	1.97	53	86	34.50	12	37
7	SVT/Lentil (2022-23)/8	770	1.84	53	86	31.50	12	35
8	SVT/Lentil (2022-23)/9	750	1.81	53	85	32.70	12	36
Mean		**17.10**	**0.06**	**1.40**	**0.95**	**1.40**	**0.96**	**1.92**
SE(m)±		**24.18**	**0.08**	**1.98**	**1.35**	**1.98**	**1.36**	**2.72**
CD(P=0.05)		**51.86**	**0.17**	**4.24**	**2.89**	**4.25**	**2.92**	**5.83**
CV (%)		**3.36**	**4.70**	**4.56**	**1.93**	**7.27**	**10.77**	**8.68**

Correlation

The correlation matrix had been calculated at 5% and 1 % level of significance which is tabulated in Table 3. Yield is the most promising factor for any crop at a farmer's sight of view because it improves their socio-economic status (Singh *et al.*, 2021). The total yield of any crop is associated with its yield attributes like plant height, days to 50% of flowering, number of nodes per plant, days to maturity and number of branches. Higher the yield attributes higher photosynthetic rate produces high yield [6].

Yield of the crop was positively and significantly correlated with various yield attributing characters viz., 100 seed weight (0.868**), maturity (0.731*), number of branches per plant (0.958**), and number pods per plant (0.942**)

Table 3: Correlation matrix (r value) of Yield and yield attributes

Parameters	Seed Yield (Kg/ha)	100 Seed weight (g)	50% Flowering (Days)	Maturity (Days)	Plant height (cm)	No. of branches/plant	No. of Pods/plant
Seed Yield (Kg/ha)	1						
100 Seed weight (g)	0.868**	1					
50% Flowering (Days)	0.224	0.023	1				
Maturity (Days)	0.731*	0.543	0.060	1			
Plant height (cm)	0.290	0.478	0.447	0.189	1		
No. of branches/plant	0.958**	0.933**	0.202	0.620	0.352	1	
No. of Pods/plant	0.942**	0.838**	0.280	0.808*	0.398	0.931**	1
** Significant at 0.01							
* Significant at 0.05							

Conclusion

Out of eight genotypes trailed, SVT/Lentil (2022-23)/6 lentil variety recorded superiority of yield (1200 kg/ha) and yield attributing characters. Therefore, SVT/Lentil (2022-23)/6 may be a suitable genotype for Siwan, Bihar region in terms of higher yield obtained followed by SVT/Lentil (2022-23)/5 which recorded a yield if 1050 kg/ha. Further multi multi-location trials will confirm the suitability of these varietal lines tested and further their performance under climate climate-changing scenarios.

Future Scope of the Study

The identified climate-resilient lentil genotypes can be further evaluated across multi-location trials and Agro-Climatic Zones (ACZs) to validate their yield stability and adaptability. Additionally, integrating these genotypes into breeding programs and promoting them through farmer-participatory approaches can enhance pulse productivity and sustainability under changing climatic scenario.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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References

1. Acquaah G (2012) Principles of plant genetics and breeding. 2nd ed. Hoboken, NJ, Wiley. 740 p.

2. Amjad M, Anjum MA (2002) Performance of nine cultivars under Faisalabad conditions. Pak J Agric Sci 39: 16-19.

3. Delahunty JA, Jason D, Brand D J, Nuttall GJ (2023) Field screening of lentil (*Lens Culinaris*) for high-temperature tolerance. Agronomy, 13 (7): 1753. https://doi.org/10.3390/agronomy13071753

4. Dimitrios NV, Christos N, Anastasia K, Dimitrios B, Evangelia T, et al (2021) Identification of the Optimum Environments for the high yield and quality traits of lentil genotypes evaluated in multi-location trials. Sustainability, 13(15): 8247. https://doi.org/10.3390/su13158247

5. Oswalt RJ, Papias HB (2022) Participatory breeding for improving legume landraces in small-scale farming. Adv Leg Sust. Inten. Academic Press. 575-594.

6. Singh S, Pandey SK, Singh MP, Verma RK, Singh VB, Singh PK (2021) Varietal trial of vegetable pea to induce the yield efficiency of farmers of district Chandauli. The Pharma Innovation Journal, SP-10(4): 92-94.

